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Eqwin Turbine – The Break Through For Wind Energy Implementation In Malaysia

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Abstract:

Malaysia experiences wind of strength 3-4m/s average annually. Hence the wind turbine already existing in the world market is not feasible economically to be implemented in Malaysia since it operates in the wind strength of 8-15m/s. Thus the aim of the research work is to establish a suitable low wind speed wind turbine for electricity generation in Malaysia. After nearly 15 years of research work, a low wind speed wind turbine based on the average wind speed of Malaysia has been successfully designed, built and tested. This particular wind turbine is called “Eqwin Turbine”. Eqwin is the short form of Equatorial Wind and thus this particular type of wind turbine is not only good for Malaysia but also for all countries in the equatorial regions. Eqwin starts to operate in wind speed of as low as 2.5 m/s and has been designed to have its maximum rating at 5m/s wind. The structures have been designed to withstand the Malaysia once in 50 years wind speed of 23 m/s. The design had been taken into consideration of the easiness of local manufacturing (manpower and technology), availability of material and installation to ensure effectively low production cost. Estimated Eqwin will have a minimum lifetime of 15 years with very nearly maintenance free. The tested prototype was of 3m diameter capable of producing 0.5 -1.5 kW maximum power in wind speed ranges from 3 – 5 m/s at a height of 10m above ground. Currently work is being concentrated at building a 10m diameter prototype to operate at 30m height for enhancing wind energy harness. To justify the quantum of Eqwin usage in Malaysia, wind power maps for Peninsular Malaysia, Sabah and Sarawak had also been developed. The maps show that Eqwin Turbines could be used for electricity generation in about 60% of the country, especially good in rural areas of Sabah and Sarawak where power grid is not available. Eqwin Turbine is the break through for wind energy implementation in Malaysia and being described in detail in the paper.

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1. Introduction

Since the awareness of the fossil fuel reserve will be finishing in the very near future, globally people had been working seriously in looking for all possible alternative energies available. Work on utilizing wind energy as one of the renewable energy source had long been undertaken and countries in Europe had come out as the champions in this field, resulting in many European countries have enjoying wind energy. The wind turbine technology had been successfully developed in Europe. The success in Europe had influenced other countries around the globe including Malaysia. From the feasibility study done [22], it was found that the wind turbine developed in Europe was not feasible to be implemented in Malaysia since the country average wind speed is in the order of 3-5 m/s depending on locations whereas the average wind velocity needed for successful operations of the European wind turbine need an average wind speed of more than 8 m/s. Thus the need to develop wind turbine that could economically operate in low speed wind had become an important agenda for a group of researchers in UTM since 1989. The success in developing this type of wind turbine will one day be achieved and be useful to Malaysia in providing electricity to the islands and the rural far interior and high mountainous areas of the country where supply from the national grid is not available and feasible. Throughout years of hard work[4, 7-9, 11-22], and in 2000 a breakthrough had been established via the successfully development of the 0.5 - 1.5 kW Eqwin Turbine. The history of the research work and the Eqwin turbine breakthrough are being highlighted in this paper.

2. History of Research Work

The success of wind energy implementation in Europe had triggered the interest of a number of researchers and government agencies to implement the said technology in Malaysia. In line with this effort, a group of researchers in Universiti Teknologi Malaysia (UTM) headed by Mr. A.A.Wahab and now Prof. Ir. Dr. A.A.Wahab conducted a feasibility study as early as the year 1987. The study gave a little distressing result that indicated the non-feasible implementation of the wind energy technology in Malaysia [22]. This was due to the too low average annual wind speed of 3-5 m/s experienced in Malaysia that could hardly operate the European wind energy harness machines since those machines need an average annual wind speed of not less than 8 m/s for commercially viable implementation. With this result, the group changed the study of implementation strategies to a research and development (R&D) strategy for developing a new kind of wind energy harness machines that utilizes low wind speed in the range of 3-5 m/s. The group classified this type of wind machine as Low Wind Speed Wind Turbine (LWSWT).

The first wind turbine developed by this group was just for the purpose of studying the working of a wind turbine in the hope that a working wind turbine either for water pumping or electricity generation could be developed in the near future. The design of the said wind turbine took place in 1992/93 but was only able to be fabricated and installed at UTM in 1995.

With the experience gained from the designing and fabricating the 1st prototype together with some knowledge of how wind turbine works, a second prototype was successfully designed and fabricated by the group but this time the wind turbine was designed for water pumping. This 2nd prototype was operated in 1997 [18-21]. It was recorded that the prototype had the capability of pumping 15 liters of water per minute to a height of 10 meters above ground under the action of 3 m/s wind. This

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type of wind turbine is good to be used for supplying water to peoples and agricultural activities (plant and animal) in the remote areas and also for recreation purposes such as the running of water fountains in the courtyard or public recreational places. The prototype rotor was 3 meters in diameter.

Further success in developing LWSWT was achieved in 1999 when the group had successfully design and fabricated the 3rd wind turbine prototype [15-17]. At this particular time the LWSWT was not for water pumping but for producing electricity by harnessing power from the wind. Figure 1 shows the LWSWT prototype 3. The difference between this 3rd prototype and the earlier two prototypes was that the 3rd prototype was equipped with a 3 metal bladed rotor while the earlier two prototypes made use of fabric bladed rotors. This prototype was installed and tested in Pulau Tioman, Pahang. With the rotor diameter of 3 meters, this prototype was capable of producing 2.1 KwH of electricity daily [4,7,11] on the island average wind strength of 3 m/s.

Figure 1: 3rd LWSWT Prototype (1999)

An outstanding achievement in developing LWSWT for electricity generation was achieved in 2000 [4,7-9,13,14] when the group had come up with the 4th prototype. This 4th prototype is equipped with a special designed metal bladed rotor. It had undergone series of laboratory tests and a short field trial. The results obtained were very impressive portraying its suitability to produce electricity from wind strength of Malaysia. Hence it is also suitable to be implemented in countries of similar wind strength i.e. countries in the Equatorial Region of the world. As up-to-date, this is the first breakthrough ever recorded in the effort of utilizing wind energy for electricity generation in Malaysia. The said prototype will be discussed in details in the following sub-heading.

3. The Breakthrough

3.1 Eqwin Turbine

The big breakthrough in developing LWSWT for producing electricity from energy in the low speed Equatorial wind especially in Malaysia is the successful design, fabrication and testing of the 4th LWSWT prototype. This prototype is branded as “EQWIN TURBINE”.

This 1st Eqwin Turbine prototype[1,4,8,9] has a rotor of 5 meter diameter and utilizing 2 different sets of blades i.e. a set of 2.5 meter blades and a set of 0.75 meter blades. The shorter blades are called the “STARTER BLADES” while the longer ones are called the “POWER BLADES”. The starter blades are meant for helping the rotor to overcome the starting torque of the rotor in order to get started rotating easily. Once the rotor rotates the power blades will do the rest of the job in harnessing energy from the wind. The rotation of the rotor is translated into the

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rotation of the generator which in turn producing electricity.

The rotor, turntable and tower of the wind turbine are all made from metals that are easily available in Malaysia and the fabrication processes are all of simple technology that could be done in any fabrication workshop in the country. The cost of fabrication of the 1st Eqwin Turbine prototype was estimated in the order of RM 80,000 and it is postulated that the cost will reduce to about RM 50,000 if being mass produced.

3.2 Laboratory and Field Tests

The first prototype was tested in the indoor testing facility in order to establish its performance characteristics as shown in Figure 2(a). It has also undergone field test for a few months in order to monitor its performance in Malaysia natural wind conditions as shown in Figure 2(b). Based on the laboratory and field tests, it is anticipated that Eqwin Turbine will be able to generate 500 to 1500 watts of electricity under the action of 3 to 5 m/s wind [7-9].

Figure 2: 4th LWSWT Prototype (2000)

3.3 Quantum of Application

The Eqwin turbine is specially designed to work in wind regions of average velocity of 3 – 5 m/s. Thus in order to estimate its quantum application in the country, wind power map of Malaysia [2,3,5-7,10,12] had been developed. The map shows that the Eqwin Turbine could be utilized to produce electricity in about 60% of the area of the country indicating that this type of wind turbine is suitable not only for stand alone applications but also for wind farming.

Malaysia is situated in the equatorial wind zone of the globe, thus Eqwin Turbines could also be of an advantage to countries in the same wind zone as shown in Figure 3.

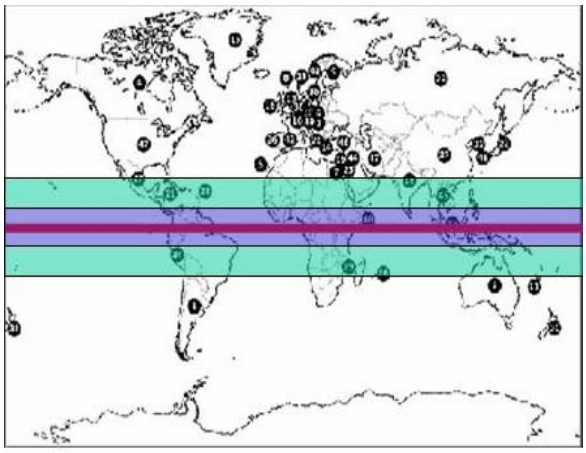

Figure 3: Zone of Similar Wind Strength

4. Further Work

Since the 8th Malaysia Plan, the government has been emphasing on the use of renewable energy as one of the country's source of energy and recently the Prime Minister of Malaysia, the beloved Datuk Sri Abdullah Ahmad Badawi has seen a great possibility of utilizing wind energy in Banggi Island, an island of the coast of Sabah. And now the Ministry of Science, Technology and Innovation (MOSTI) is putting an effort to implement wind energy

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harness on the island. In line with this move, researchers in UTHM is actively engaged in developing a bigger Eqwin Turbine, each turbine will be capable of producing 0.6 – 3.0 kW electricity in 3 – 5m/s wind. The current prototype has the capability of producing 0.5 – 1.5 kW of energy. Information on Eqwin Turbine could be obtained from Prof Ir Dr Hj Abas Bin Ab Wahab, Faculty of Mechanical Engineering, UTHM, 86400 Parit Raja, Batu Pahat, Johor. A demonstration plant has yet to be built in the near future for creating public awareness and interest in energy from the wind and also for establishing commercially proven data of the turbine operation. What people say "Seeing is believing".

5. Conclusion

The success of developing Eqwin Turbine is the engineering breakthrough in looking for wind turbine for harnessing energy from low speed wind. This type of wind turbines is very useful and beneficial for countries situated in the equatorial wind belt where the use of high wind speed wind turbine is not economically feasible. The implementation of Eqwin Turbines is very beneficial in areas where the supply from national main grid is not available. In Malaysia alone, Eqwin Turbines has the potential to be installed in about 60% of the whole country.

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